Gas Journal

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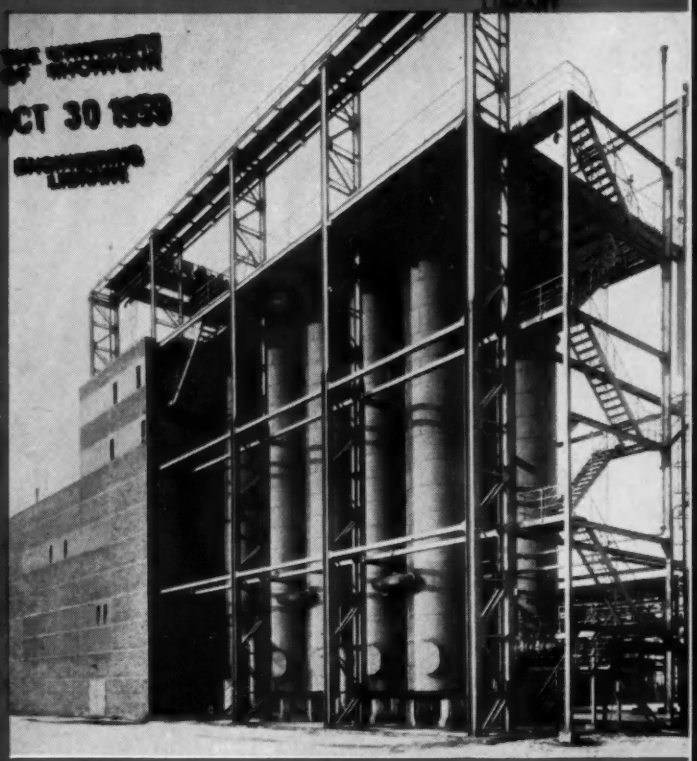

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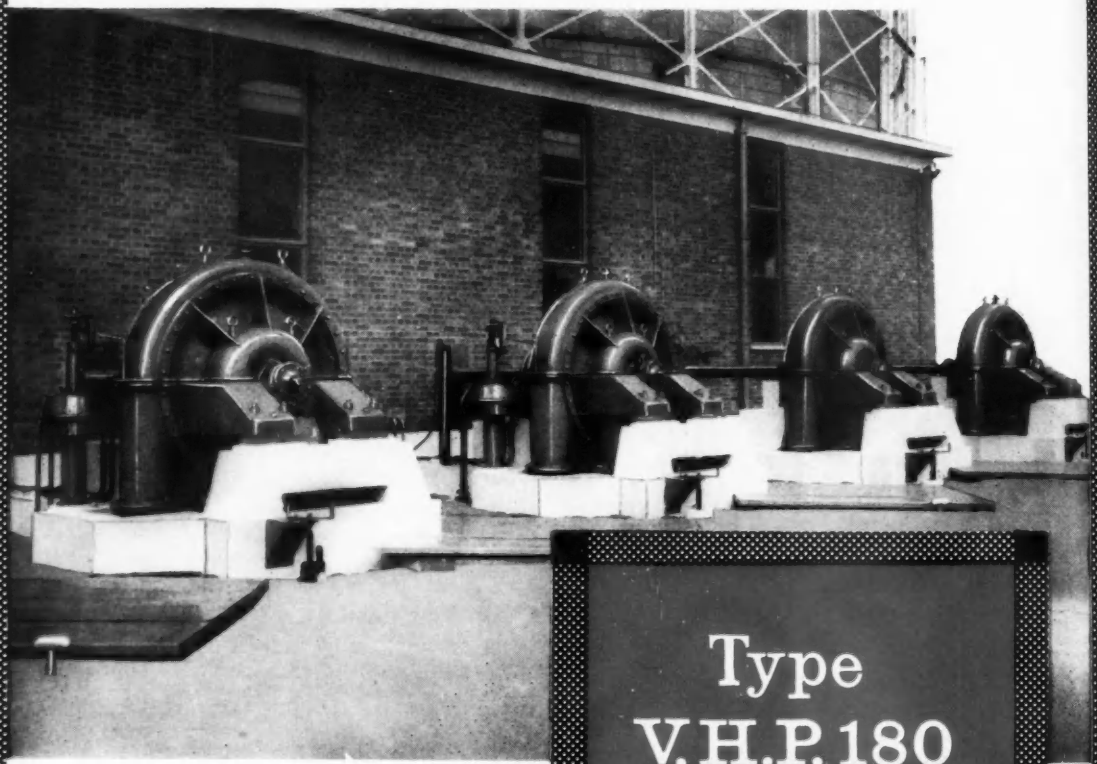

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Gas Journal

VOL. 300 *No. 5014* *October 7, 1959*

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CONTENTS

EDITORIAL COMMENT

Cat Among the Pigeons - 25
The Dame - 26
Oil and Gas - 26

NEWS OF CURRENT EVENTS

Personal - 29
Obituary - 29
Diary - 29
National First Aid Competition Winners - 30
Public Service to Become Newspaper - 30
E.G.B. Announces New Tariffs - 31
The 20th Century Apprentices - 31
New Coke Prices for the Scots - 31
Meet Willie Morris - 31
News In Brief - 31
Centralised Accounting at Bath - 32
New Books - 44

TECHNICAL RECORD

The Affects of the Addition of Butane to Town Gas on its Combustion Characteristics. By M. G. Gilbert and F. C. Moody - 33
Operation of Liquid and Gastechnik Purification Plants at Cardiff. By J. Powdrill - 47

GAS IN INDUSTRY SUPPLEMENT

Editorial Comment: Gas Firing is Competitive - 231
World Famous Bedford Truck Components get the Heat Treatment. By Eric Ford - 232
Radiant Heating Sell Gas-fired Incinerators - 238
Automatic Gas Controls. By G. Howse and G. W. Jobbins - 239
Industrial Sales Organisations Must Locate Plants Which Need Better Fuel Service - 242
Ceramics Costs Reduced by Gas - 244
Introducing the Parasheet - 245
Know Your Kitchen Equipment. By GAStronome - 246

PUBLISHERS' NOTICE SEE PAGE 53

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the study of movement

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Gas Journal

VOLUME 300 No. 5014 OCTOBER 7, 1959 111th YEAR

Cat Among the Pigeons

WITH a general election only days away and his own retirement to look forward to in three months, Sir Harold Smith chose last week to express sentiments which implied an unusually partisan view for the chairman of a nationalised industry, sentiments which were bound to make headlines in a number of newspapers and to anger the harassed National Coal Board and its employees. What he said was not particularly new—he has spoken along similar lines on several occasions—but it was put more forcefully and at a time when negotiations are taking place between the Gas Council and the N.C.B. and when everyone is alert for political overtones.

At the heart of the matter was a principle, one which has underlaid the whole of the Gas Council's policies since its inception. That principle rests on the belief that the gas industry has a statutory duty to provide the consumer with the best possible service at the lowest possible price, and that it cannot be implemented if it is expected to help a lame Coal Board over its stile, or indeed to feel obligated towards anyone except its customers. Such an interpretation of the Council's function is clearly at variance with the Socialist Party's plea for a national fuel policy which, they maintain in their manifesto, is a ' crying need '.

Of course, it all depends on what you mean by a national fuel policy. The Labour Party would probably describe it as a form of co-ordination in which the various interests of coal, gas, electricity and nuclear energy are viewed as a whole. Certain basic questions immediately come to mind: In practice, how would one ensure that such a policy was scrupulously fair in its attitude to the various industries and would not weigh its favours towards one or another? Would a policy of this nature be in the national interest in that it would, ostensibly at any rate, enable customers to receive each and every fuel at the lowest possible price? If one accepts the fact that, from a long-term viewpoint, it is desirable to assist an industry in certain ways and for a certain time, where should one draw the line? Because if too much help is given, that becomes in fact a subsidy which must be paid for by the other industries and, ultimately, by the customer.

The existence of a national fuel policy some years ago might have prevented the Coal Board charging the gas industry prices which were, to quote the words Sir Harold is supposed to have used, ' out of all proportion to those charged to the domestic consumer.' It might thereby have kept gas clear of the danger point at which a product is priced out of the market. Fortunately we have not reached the precipice but we have been, and indeed still are, upleasantly close. It might reasonably have been argued that such action would have kept the gas industry in a healthier position; and it would not necessarily have damaged the Coal Board whose revenue would have to come, at least in part, from other sources. Moreover, the phenomenal rate of expansion in the industrial and domestic market for oil might have been curbed.

However, no such helping hand was forthcoming, and perhaps it was just as well. The gas industry, faced with the risk of extinction if it remained solely dependent on coal as a feedstock, set about solving its own problems in its own way. With no little ingenuity it set about the task of becoming independent of coal. To a substantial degree it has achieved that aim, although far too little is known about the cost per therm of gas obtained by non-traditional means.

All this means that Sir Harold had every justification for making it known that the gas industry had succeeded in evading the monopoly price for gas coal exacted by the Coal Board and that it could no longer be crippled by the coal shortages which hampered it during the past ten years. He was able to show how, despite great difficulties, given the flexibility of movement in a state of free competition, gas could hold its own. And he is

reported as saying : ' We want to be free in the gas industry to progress as we want to progress, and to serve the gas consumer. I have told this to the fuel committee of the Labour party and also to our own trade unions. The Unions have told us they will back us in our future policy. We don't want to be deflected from this . . . . if Britain gets the national gas grid—we have planned for it in ten years time— this will be the most efficient method of carrying fuel in this country.

Fair enough! It would be foolish to make too great an issue of the purely political implications. After all, when an industry has had to navigate such difficult waters, how can its leader maintain strict neutrality when describing its affairs? Nevertheless Sir Harold has certainly put the cat among the pigeons; but it was hardly his fault if, to mix our ornithology, the pigeons turned out to be such sitting ducks!

The Dame

THERE must be many in the industry who were grieved to learn of the death of Dame Vera Laughton Mathews, for in her comparatively short association with gas she impressed all with whom she came in contact with the force and charm of her personality. Women in industry have a tendency to conform to certain clearly defined types. No such classification could be applied to Dame Vera, whose qualities of vision, simplicity, obstinacy and great warmth of heart made her quite unique.

When ' The Dame ', as she was affectionately known, was appointed adviser on women's affairs to the Gas Council it is doubtful whether her conception of her duties exactly coincided with those of her colleagues. Perhaps she had visions of becoming something of a champion of women in the industry concerning herself with their interests and conditions of service. Certainly her background and character well suited her for such a role, but it was not to be. Instead her insatiable appetite for work and her imaginative powers were directed into the creation of a series of ambitious national competitions and into helping to establish the Women's Gas Federation as an important and useful adjunct to the nationalised industry. To these tasks she brought a determination which bulldozed all opposition, and a natural charm which made friends of her opponents. Indeed, her capacity for friendship was prodigious and her entirely uninhibited attitude towards life was nowhere more noticeable than in the catholicity of the friendships she made with people at all levels and in all walks of life.

Dame Vera was a big woman—big physically, mentally and spiritually. In her was contrasted the brain and physical strength of a man with a very feminine interest in clothes and creature comforts. Those who knew the circumstances of the last years of her life will not need to be told of her courage, and those who have argued with her will bear witness to her long—often uncomfortably long—memory and ability to strike unerringly at the chink in her opponent's armour. The combination of some of her qualities might easily have made her a rather forbidding person. That she was nothing of the sort was due primarily to her sense of humour, never keener than when the joke was on herself. Indeed, we shall always remember the relish with which she told the story of the American journalist who had described her in an article, as a ' grand old lady sea-dog! '

Oil and Gas

DR. James Burns scored a resounding success with his speech, entitled ' Oil and Gas,' at the annual dinner of the Council of British Manufacturers of Petroleum Equipment last week. The invitation to be the guest speaker to this highly influential body—there were nearly 1,500 present at Grosvenor House—was a reflection of two things : Recognition by the oil industry of its strengthening link with gas, and its respect for the formidable attainment of a man who has shown himself to be not only an engineer of distinction but something of a pioneer—and not only in methane!

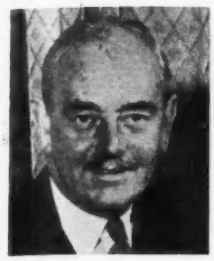
One of the characteristics of the C.B.M.P.E. (Why choose an unpronouncable set of initials?) is leaving a speaker who fails to hold their interest in little doubt of the fact. No demonstration of disinterest was necessary on this occasion, for Dr. Burns, apparently unperturbed at finding himself sailing in such oily waters, was in sparkling form and had his audience with him every inch of the way, and this despite the fact that his talk was more technical than is the custom at such functions.

He traced the relationship between the two industries from 1890 to the present day, making particular reference to the ' Methane Pioneer '. He pointed out that the oil industry had obviously shown much interest in these developments ' for there might be some fear that they would affect the well established oil markets in this country, but no doubt consolation is drawn from the fact that the oil industry in America is prospering greatly despite the intense competition from Texas natural gas for heating purposes in New York.'

Dr. Burns stressed the impending change in the transportation of fuel. ' At the present time,' he said, ' the major portion of our coal and oil raw materials in the gas industry, are transported to the point of usage. The situation has now arrived when it is no longer economic to transport these materials overground, but rather to transport the products in the form of gas underground by pipeline. Thus with coal as a raw material it is likely that plants of the future will be placed on the coalfield with minimum transportation charges, with oil products transported thereto by pipe-line to produce a gas suitable for national distribution. While at the great oil receiving centres of the country, there will be set up plants both for base load and peak load purposes, using oil as a raw material, and again feeding into a countrywide distribution system.'

He concluded : ' There does appear, therefore, at present price relationships, to be a basis for useful collaboration between coal and oil to provide a fuel service on more economic lines than is possible today.'

Personal notes



MR. R. N. B. D. BRUCE, O.B.E., T.D., the present Deputy Chairman of the North Thames Gas Board, has been appointed Chairman of the South Eastern Gas Board in succession to MR. W. K. HUTCHISON who, as recently announced, has been appointed Deputy Chairman of the Gas Council. DR. J. BURNS succeeds Mr. Bruce as Deputy Chairman of the North Thames Gas Board. Both appointments date from January 1 next. Mr. Bruce, who is 52, was educated at Harrow and Magdalen College, Oxford. He joined the Gas Light and Coke Company in 1929 as a research chemist. In 1935 he was seconded to the South Eastern Gas Corporation and acted as technical liaison officer on the manufacture and supply side between his and associated companies. While assistant to the general manager of the Gas Light and Coke Company, a position he attained in 1937, he was secretary of the London and Counties Road Tar Association, secretary of the Gas Coke Export Association and secretary of the London and Counties Gas Development Association. Mr. Bruce, who has been a member of the Territorial Army since 1931, was a company commander in the Rangers at the start of the war. He served in the Middle East and Greece where he was wounded and later in the Western Desert. When the Rangers were reduced to cadre strength he became Director of Materials in the Middle East Supply Centre, G.H.Q. Since the end of the war he has been president of the Rangers Regimental Old Comrades' Association and has been awarded the Territorial Decoration and Bar. Shortly after his return from war service, he was appointed controller of industrial relations for the company and, when the gas industry was nationalised, became staff controller for the North Thames Gas Board.

He is a member of several companies associated with the Board and is also a member of a number of associations connected with tar, as well as being a vice-Chairman of the British Sulphate of Ammonia Federation.

Dr. James Burns, who will become Deputy Chairman of the North Thames Gas Board, was born in Beauly, Inverneshire, and educated at the Royal Academy, Inverness and Aberdeen University. After winning a Carnegie Fellowship he entered Cambridge University to carry out research in chemistry for three years. He joined the research department of the Gas Light and Coke Company from Cambridge and after a year's work there was seconded to another company to undertake development work in Germany. He also worked for a while in Hungary. On the outbreak of war he was engaged on the production side of gas making at Bromley and later at Stratford. At the end of the war he was appointed group engineer in charge of Beckton. Later, when the industry was nationalised, he became deputy chief engineer and then chief engineer of the North Thames Gas Board. He was appointed a full-time member of the Board about six months ago.

DR. A. B. BADGER, Industrial Relations Officer of the Gas Council, left London recently on the first stage of a journey to the United States. After flying to Paris, he joined up with a party of 18 other management and labour experts and then flew on to America, arriving in New York on October 2. The group is taking part in a programme of labour relations studies arranged by the European Productivity Agency, which is a department of O.E.E.C. Dr. Badger, one of the four men from the U.K. in the party, will study the teaching of labour relations subjects in the U.S.A., and during the month he will spend in the country will study the functioning of United States university management/labour relations departments. This will entail studies at the institutes of management and labour relations at three universities—Rutgers (New Jersey), Illinois, and Cornell (New York). The party is due to return to Paris on October 31.

MR. G. BARLOW, Managing Director of Meters Ltd., has also been appointed Managing Director of Thomas Glover and Co. Ltd. MR. J. P. SMITH has been appointed Sales Director of both companies with, under him, MR. S. HALL as Northern Sales Director and MR. D. SIME as Southern Sales Director. MR. W. K. TATE, while remaining on the boards of both companies, gives up the managing directorship of the former to devote himself full-time to other activities being developed within the Glover and Main Group.

MAJOR R. J. A. HOCKENHULL has taken up duty as Senior Study Officer of the Central Division of the Scottish Gas Board. His appointment is part of a works study department, which is being created at the Divisional headquarters in Perth. Major Hockenhull recently retired from the Regular Army. He was O/C R.A.S.C. Fleet Administrative Unit, a branch of the R.A.S.C. Work Study and Advisory Unit.

Diary

October 9. — JUNIOR INSTITUTION OF ENGINEERS: Pepys House, Rochester Row, Westminster, S.W.1. 'Some Aspects of Industrial Space Heating,' by D. E. Edminson. 7 p.m.

October 15.—COMBUSTION ENGINEERING ASSOCIATION: Queen's Hotel, Birmingham. Fuel Forum: Open Discussion on Fuel Economy. 10 a.m.

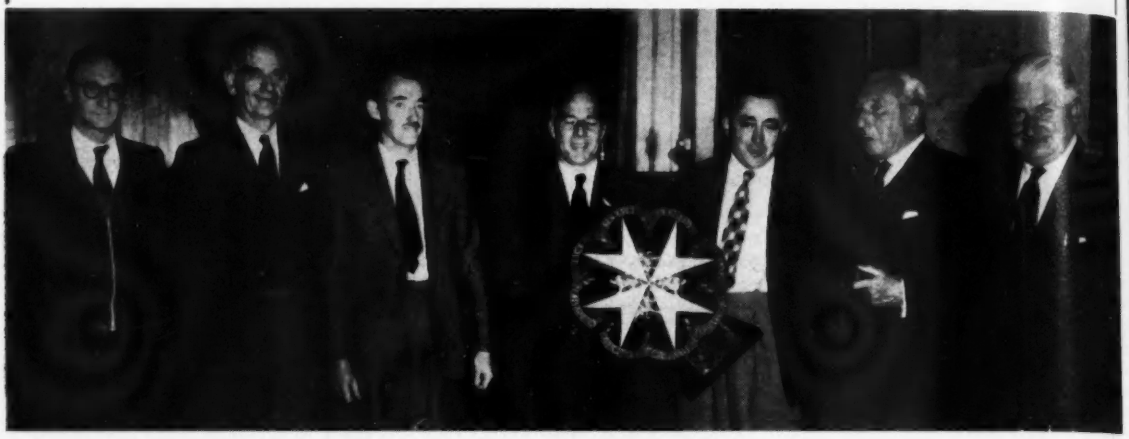
October 16.—JUNIOR INSTITUTION OF ENGINEERS: Pepys House, Rochester Row, Westminster, S.W.1. 'Programming a Computer,' by A. C. Quarterman. 7 p.m.

Obituary

MR. BERNARD BROWNE

R.B.G. writes: I am honoured to be invited to refer to the passing of an outstanding personality, the late Mr. Bernard Frederick Browne, O.B.E. It had been my privilege to know him, and his wife, for some 35 years, and his passing finally breaks an important link with the South American gas industry of the pre-1914 days. Bernard Browne was a son of Mr. A. F. Browne of Vauxhall, who was a gas engineer of high standing in the 1900's and was of special significance to those who had to pass City and Guild examinations, for which he was examiner in gas subjects for several years. An untiring worker, clever organiser and practical mechanical and chemical engineer, Bernard Browne lost no opportunity of using his gifted ability in the organisations which he managed in Buenos Aires and Santos. He regarded work, both paid and voluntary as a privilege and challenge and duties of a widely varying character were carried out quickly, efficiently and with verve. He was widely read, and with a phenominal memory had the capacity to retain and draw upon his experience and his reading. His keen sense of fun was often a cloak to a penetrating brain and wide experience and his Victorian courtesy and consideration for others made him many friends in every walk of life, all of whom he treated alike. Gifted with a strong constitution, he never spared himself physically or mentally. To meet him was a tonic and often resulted in difficulties and worries being resolved into correct proportion. In his conception of social welfare he was far ahead of his time. He worked unceasingly and with great success to improve the lot, not only of those who served him, but also of untold numbers in the communities in which he lived. His example, captivating personality, good humour and never failing jokes, were an inspiration to all.

National first aid competition winners



Sir Harold Smith (second from right), Chairman of the Gas Council, and Mr. K. L. Pearce (extreme right), Divisional General Manager of the Derby Division of the East Midlands Gas Board, join the successful team from the East Midlands Board after Sir Harold had presented them with the trophy. The team members were:—Mr. T. Johnson (Captain); Mr. C. Collier; Mr. E. Stone; Mr. H. Kerslake and Mr. H. S. Newell (Reserve).

A NEW champion for the gas industry was found on September 25 when, at Friends' House, London, the East Midlands Gas Board men's team won the national first aid competition. They were second last year, one point behind North Thames.

They will come to London again on November 19 to represent the gas industry in the Grand Prior's trophy competition, against teams from the police, railways, Post Office, and the St. John Ambulance Brigade.

The women's competition was a great tribute to the North Western team, which carried off the title for the third time out of the four years it has been held. It was an entirely different team this time, coming from Northwich.

Sir Harold Smith, Chairman of the Gas Council, presenting the trophies and plaques, said it was a good thing to see a new team winning for the men. A good deal of sacrifice was needed to maintain efficient first aid services, for competitors gave up their spare time to it.

The Director-General of the St. John Ambulance Association, under whose auspices the competitions are held, paid a special tribute to Sir Harold for his long and devoted support of the work in the gas industry.

This was the ninth competition of the series.

The team from the North Western Gas Board, which won the women's competition, receiving the Trophy from Sir Harold Smith, Chairman of the Gas Council. The team members were:—Miss N. Hooley (Captain); Mrs. N. M. Eyes; Miss W. Littler; Miss E. M. Hearn and Miss R. Davenport (Reserve).

The Results

The full results were as follows (maximum points 400—200 for team test and 200 for individual test).

Men

	Individual	*Team*	*Total*
1. East Midlands Gas Board	158	152	310
2. North Thames Gas Board	135	164½	299½
3. North Western Gas Board	147	150	297
4. North Eastern Gas Board	142	150	292
5. Eastern Gas Board	149	131	280
6. Scottish Gas Board	120	156	276
7. South Eastern Gas Board	116	154½	270½
8. South Western Gas Board	125	137	262
9. West Midlands Gas Board	123	138½	261½
10. Wales Gas Board	120	137½	257½
11. Northern Gas Board	114	126	240
12. Southern Gas Board	109	108	217

Women

	Individual	*Team*	*Total*
1. North Western Gas Board	159	166½	325½
2. Scottish Gas Board	149	167	316
3. West Midlands Gas Board	174	124½	298½
4. Northern Gas Board	170	103½	273½
5. North Eastern Gas Board	143	127½	270½
6. East Midlands Gas Board	164	92	256
7. South Western Gas Board	122	127½	249½
8. Southern Gas Board	102	55	157

PUBLIC SERVICE TO BECOME NEWSPAPER

AFTER more than 50 years as a magazine, *Public Service*, official journal of 'Britain's biggest "blackcoat" trade union,' the National and Local Government Officers' Association, is being converted into a newspaper. It will, it is believed, have the biggest circulation of any trade union publication in the world —over 280,000.

The change is a direct result of the recent printing dispute. When that stopped publication of its magazine, the Association published an emergency newspaper. Members so liked this that they asked for it to be made permanent.

The 20th Century apprentices

SOME revealing facts for those who constantly criticise the way of life of modern youth are contained in a survey conducted among 400 apprentices attending the annual Industrial Welfare Society's apprentice conferences recently at Oxford.

The survey shows that the typical industrial apprentice of the mid-20th century is aged between 17½ and 22; does not follow his father's trade; has money in the bank; spends only 5s. to 10s. a week on clothes; probably went to a secondary grammar school; lives at home; is likely to own a car; and may well be thinking of emigration. He may even be married.

Class distinction

While none of them consider that they belong to the upper class, only 25 per cent. assert that they come from the working class. Sixty per cent. believe that they belong to the middle or lower middle classes. And 15 per cent. do not believe in class at all.

£1 to £2 a week is spent on entertainment and personal purchases by nearly 40% of apprentices. About 15% spend less than £1, about 20% between £2 and £3, and about 10% from £3 to £4.

Most of the lads have money saved: 40% of them up to £50, nearly 20% between £50 and £100, nearly 20% between £100 and £250, and more than 5% over £250.

Saving and spending

Half the apprentices have life insurance policies; nearly half have Post Office savings accounts; more than a quarter have bank accounts; another quarter have trustee savings bank accounts. Only 7% hold Premium Bonds.

Nearly 20% own cars; 60% own bicycles; 30% own scooters or motorcycles. Only 35 per cent. go to church regularly. Nearly 60% do not belong to a trades union.

E.G.B. announces new tariffs

FOR DOMESTIC AND COMMERCIAL USERS

THE Eastern Gas Board recently announced new tariffs for domestic and commercial consumers, applicable as from September 30.

The domestic optional two-part tariff, of advantage to consumers with space heaters in regular use, has been marginally cheapened as a result of simplification. Thermal charges previously expressed as percentages of the flat rate are now shown in terms of shillings and pence per therm, having been rounded off to the nearest ¼d. in favour of the consumer.

In the Tottenham and Watford Divisions, in which more than half of the Board's consumers live, the standing quarterly charge under this tariff is £1 6s. and the charge per therm for the first 100 therms a quarter is 1s. 7d. and for all additional therms 1s. 5½d.

Board's hopes

A second optional two-part tariff with a standing charge of £1 19s. a quarter has been introduced, for the larger domestic consumers. In this, the Board hopes to encourage particularly the use of domestic gas boilers for hot water and central heating and the new warm air installations which are finding increasing favour throughout the Board's area with builders and the public. The charge for gas under this tariff varies with the flat rate but, to take an example, is 1s. 5d. per therm in the Tottenham and Watford Divisions.

Specially designed for commercial premises such as hotels, restaurants and large offices is a non-domestic two-part tariff for central heating and bulk hot water. The standing quarterly charge varies according to the size of the boiler and is £2 for each 100,000 B.t.u. per hour of boiler rated capacity. The charge varies with the flat rate price and in the Tottenham and Watford Divisions is 1s. 6½d. per therm.

The tariffs are part of a big space and central heating drive which the Board now has under way throughout its area. All consumers on the existing two-part tariff, and others who may benefit from the new tariffs, are being written to individually and all salesmen have received a copy of a brochure designed to help them in selling space heaters.

Footnote.—Last year the Board sold nearly 8,000 fixed convector and hearth-type fires, apart from portables, boilers and warm air installations. Its target this year is at least to double that figure and with the new tariffs and the extremely favourable customer reaction, particularly to the new convector fires, they confidently expect to achieve this aim.

NEW COKE PRICES FOR THE SCOTS

WITH the introduction last week of the winter prices for gas coke, the Scottish Gas Board has revised its price structure and marketing arrangements for gas coke throughout the mainland of Scotland.

The large number of different prices at present in operation will be superseded by a much smaller number of prices, related to the average transport costs of raw materials and applicable to wide areas.

Prices vary from a minimum of 8s. 8d. a hundredweight in most of south and central Scotland, to a maximum of 9s. 11d. a hundredweight in the more northerly districts.

These prices apply only to coke delivered by the Scottish Gas Board in areas covered by the Board's own delivery service.

Meet Willie Morris

WHEN the signal is given for the launching of the St. Davids, Pembrokeshire, lifeboat, it serves a dual purpose. It also means that if stoker Willie Morris is on duty at the local gasworks, his relief automatically takes over—for Willie is also second coxswain of the lifeboat.

Aircraft search

Recently, as acting first coxswain, he took the lifeboat out on searches for the missing Victor bomber, now known to have crashed in the area. It is all in a day's work for Mr. Morris, son of the local gasworks Manager, to finish a spell of stoking and, still in sweat-soaked clothes and working boots, set off on a lifeboat trip to rendezvous 20 miles out to sea with a plane which has, perhaps, sighted wreckage or a patch of oil.

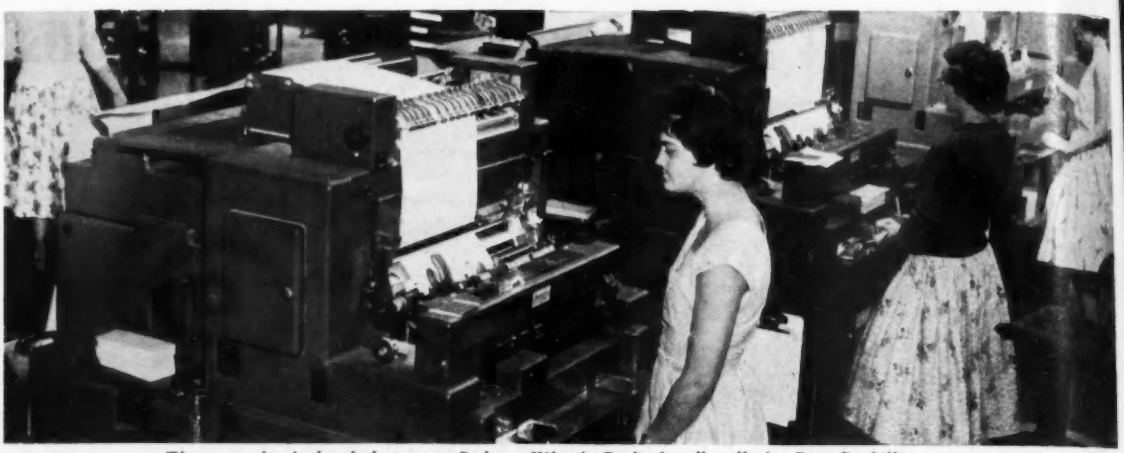
Mr. Morris, on the left, is seen here with an American couple who are touring Britain. The picture was taken during the making of a television film series, designed to acquaint Americans with their British counterparts in everyday life.

In Brief

FIRE in the retort house roof at **Crewe** gasworks on September 14 badly damaged 100 sq. ft. of roof. Employees and Crewe Fire Brigade put out the fire after more than an hour's battle.

Stoke-on-Trent is tackling the mammoth job of changing the city's street lighting from gas to electricity. The lighting on main roads has been changed to electricity, and a start is to be made on secondary roads. Later, the link roads will be dealt with.

Constructors John Brown have been awarded a contract from the East Midlands Gas Board to instal a high-pressure pipeline from coke ovens at Scunthorpe, southward to **Lincoln** and **Gainsborough.**



These mechanical tabulators at Sydney Wharf, Bath, handle all the Board's billing output.

Centralised accounting— A step forward by S.W.G.B.

NEW DEPARTMENT AT BATH OPENED BY LADY SMITH

MECHANISATION of the accounting department of the South Western Gas Board was carried a stage further on September 22 by the inauguration at Sydney Wharf, Bath, of the Board's new accounting centre. The ceremony was performed by Lady Smith, who was accompanied by Sir Harold Smith, Chairman of the Gas Council.

Almost all the Board's accounting work has now been centralised at Bath, and the electronic and other mechanisation installations deal with gas sales, hire-purchase and simple hire billings, cheque payments to suppliers, transport costing, revenue and capital accounting, and expenditure analysis, together with sections of the Board's payroll and stores records. Many types of managerial and statistical records are also produced as a by-product of these main activities.

Order placed

An investigation into the most suitable equipment culminated in the decision to place an order with Powers Samas Ltd. (now International Computers and Tabulators Ltd.) for a full range of Double 80 equipment including two programme controlled electronic computers and four Samastronic tabulators.

The first large-scale machines were delivered in 1957 and now the installation comprises over 70 machines of 40 column and double 80 types, including automatic key punches, sorters, interpolators, interpreters, reproducers and tabulators. Among the latest type of electronic equipment used by the installation are two electronic computers and a revolutionary type Samastronic tabulator. In the Despatch Department, there are paper cutters and decollators and also a Kern enveloping machine, which folds bills and envelopes them complete with suitable publicity material at the rate of over 2,000 per hour. As a general average about 10,000 bills are despatched daily.

Information

Over 100,000 documents pass through the accounting centre each day and from these various types of prime records, which emanate from the production stations and district service centres, the information is transposed into the punched cards. These are sorted and merged by various machines for the further calculating and processing operations.

The two I.C.T. programme controlled electronic computers handle a daily volume of gas and hire-purchase billing, transport records and allied statistics. The computer calculates the gas bills at the rate of two per second and when handling the payroll—a section of which has just recently been mechanised—the computer deals with the intricate calculation of hours multiplied by rates, P.A.Y.E. deductions, insurance, pensions, sickness, holidays, etc., at the rate of one complete pay calculation per second. This procedure is gradually being extended and will ultimately deal with the weekly wages payments for over 5,000 employees operating at district centres and production stations throughout the whole area of the Board.

After the calculations have been carried out on the electronic computers, the records, bills, pay slips, etc., are printed out on tabulators. At the present time, the mechanical tabulators handle the billing output, but the pay slips are printed on a Samastronic tabulator at the rate of 100 slips per minute.

Integrated

Ultimately, four of these revolutionary type machines will be installed, thus providing a centralised, fully integrated electronic data processing scheme capable of dealing with all the accounting and costing activities of the Board.

Footnote: To mark ten years of nationalisation, completion of its gas grid, the development of its interlinked major works, and its centralised accounting centre, the Board, in conjunction with International Computers and Tabulators Ltd., have produced a documentary film which was shown to the guests at the inauguration ceremony.

Canadian gas installations increase

AT the end of 1958 a total of 1,110,960 gas installations were reported in service in Canada—an increase of 9.3% over the 1,016,079 recorded in 1957.

By the end of 1958 only 35,967 customers were receiving manufactured gas compared with 67,726 in 1957 and 610,096 in 1950. Sales of natural gas service rose 13.4% during 1958 to 1,069,892 from 943,783.

From a paper to the London and Southern Junior Gas Association.

The Effects of the Addition of Butane to Town Gas on its Combustion Characteristics

By M. G. GILBERT, B.Sc., Assoc.M.Inst.Gas E., and

F. C. MOODY, B.Sc.,

WATSON HOUSE, LONDON.

THE gas industry has been a steadily increasing user of hydrocarbon oil fractions, particularly the lighter fractions, which have now become available in quantity at costs favourable to the industry.[1] They have not only proved extremely valuable in providing peak load supplementary supplies but also in providing base load gases as an alternative to the conventional town gas obtained from carbonisation of coal.

For base load supplies, a wide range of these oil fractions is being reformed in Onia-Gegi and Segas plants to provide gases with properties similar to those of normal town gas, while in certain isolated areas a mixture of butane and air is being used as an alternative to conventional town gas. To supplement the normal gas supplies at times of peak demand, butane-air mixtures can be added, or direct enrichment of gas of low calorific value with butane made in addition to other methods of producing peak load oil gases from oil fractions.[18]

Butane, either mixed with air or by direct addition to a base gas, has the great advantage that it is relatively easy to handle and to add to the gas. It can, therefore, be used at small isolated works or as an emergency supply which can be rapidly brought into operation at times of peak demand. This is important since it avoids the high cost of traditional standby gas-making plant for short periods of high gas demand.[1]

Combustion characteristics

Butane and the petroleum hydrocarbons are relatively free from sulphur compounds, an important consideration in the reduction of corrosion by products of combustion.

Unfortunately the combustion characteristics of butane and mixtures of butane with air or other diluents are very different from those of normal town gas. Problems may arise if these gases are used in appliances adjusted for normal gas and care must be taken that the combustion characteristics of any such gas mixtures with town gas remain satisfactory. Appliance performance with gases of different properties has been discussed by Gilbert and Prigg,[2] but, stated briefly, for appliances to give a satisfactory performance with a given gas it is necessary that:

1. The heat input should approximate closely to the nominal rating. Domestic appliances will behave satisfactorily if the Wobbe number is maintained within $\pm 5\%$ but in an emergency it may vary by 10%, although there will be some reduction in service as a result.

2. Flames should remain stable. Aerated flames should not light back and non-aerated flames should not lift.

3. Incomplete combustion should not occur.

4. Soot formation should not occur.

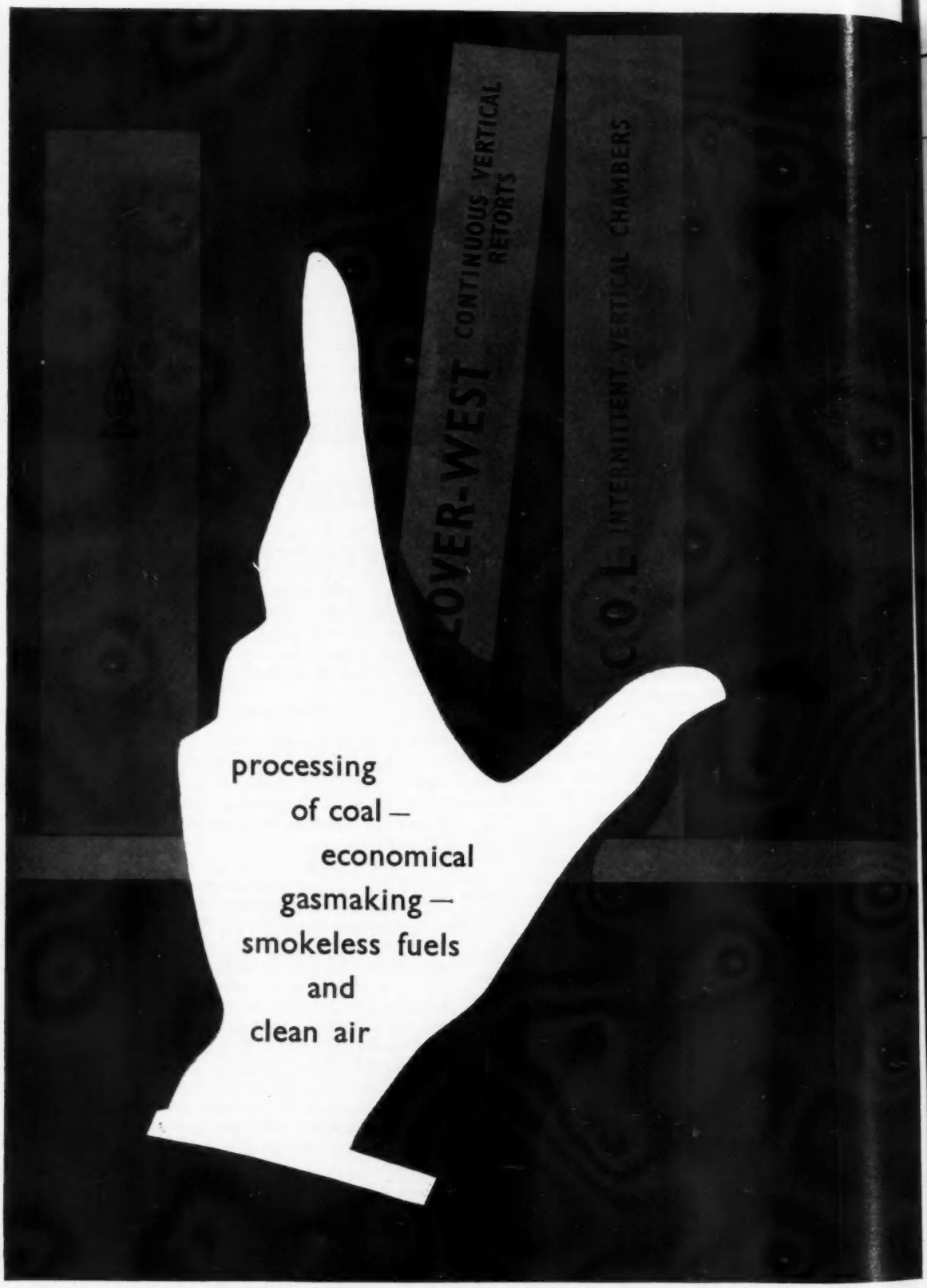
To test whether a proposed gas will continue to give a satisfactory performance is to examine a range of representative appliances on synthetically prepared gas mixtures. If the results are unsatisfactory, the proposed gas cannot replace the existing town gas but it may be used in mixtures either with the existing gas or with some other available gas. Further tests should then be carried out as to which mixtures will prove satisfactory.

Preliminary assessment

Such experimental work may be lengthy and laborious, but it may be appreciably shortened by making a preliminary theoretical assessment of the proposed gases by the method described by Gilbert and Prigg.[2] A diagram showing the Wobbe number and Weaver's flame speed factor can be drawn on which a point representing the mean gas for which the appliances are adjusted, is surrounded by boundary lines representing the limits of acceptable performance. Completeness of combustion, flame stability and heat input are functions of the Wobbe number and the flame speed of the gas. By calculating the Wobbe number and flame speed factor of any other gas and plotting the corresponding point on this diagram, the type of performance that this gas will give on the existing appliances can be assessed. The tendency for soot formation to occur cannot be represented on this diagram, because it is mainly a function of the hydrocarbon content of the gas; the presence of aromatic hydrocarbons in particular greatly increases the tendency to produce soot.

From such a diagram it is possible to decide whether a particular gas can be substituted for the existing supply and if not, which mixtures might be. Experimental work can then be confined to checking that the limiting mixtures indicated by the diagram do in fact give satisfactory performance. Fig. 1 shows the performance of gases supplied to appliances adjusted for mean G4. gas, *i.e.*, with Wobbe number 730, and on this diagram a number of familiar gases have been plotted.

The properties of some of the hydrocarbons available



WEST'S GAS IMPROVEMENT COMPANY LIMITED
MILES PLATTING, MANCHESTER 10 Telephone: COLlyhurst 2961 Telegrams: Stoker, Manchester
London: Columbia House, Aldwych, W.C.2. Tel: HOLborn 4108 C.O.L. Div.: Chandos House Buckingham Gate, S.W.1. Tel. ABBey 6012

TABLE 1
Properties of some lower hydrocarbons

Gas	Calorific value B.t.u./cu. ft.	Specific gravity, air=1	Wobbe No.	Air required for complete combustion cu. ft./cu. ft.	Calculated flame speed factor 'S'	Measured max. flame speed, cm/second
Methane	994	0·55	1,340	9·55	14·0	35
Ethane	1,758	1·05	1,758	16·70	17·0	—
Propane	2,519	1·55	2,020	23·87	16·0	39
Butane	3,333	2·08	2,310	31·0	16·0	38
Naphtha (Light petroleum distillate)	6,077	3·92	3,070	58·86	16·0	—
Benzene	3,679	2·70	2,240	35·80	25·0	—
Mean G4. gas	500	0·47	730	4·26	41·4	c. 100
Hydrogen	318	0·07	1,205	2·39	100	260
Ethylene	1,584	0·98	1,600	14·32	29·0	68
Carbon monoxide	316	0·97	321	2·39	18·0	46

are compared in Table 1 with the properties of a conventional mean G4. gas made up of coal gas and carburetted water gas.

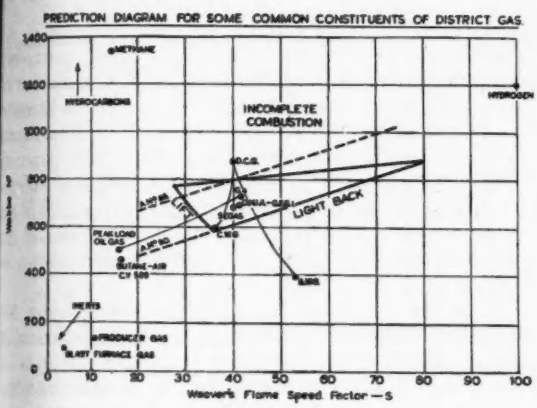


Fig. 1.

From this table and the positions of the hydrocarbons in Fig. 1 it can be seen that all have Wobbe numbers much higher than those in the range of G4. gases and that their flame speeds are much lower. They cannot therefore be used to replace conventional town gas, without first converting the appliances to operate on this gas instead of the normal distributed gas,[3] changing the composition of the hydrocarbon gas by reforming or by using the hydrocarbon in mixtures with other gases. The suitability of such mixtures can be assessed by means of the prediction diagram. The addition of either air or inerts to hydrocarbon gases produces mixtures with lower Wobbe numbers but still with low flame speeds and the flames from such mixtures have a marked tendency to lift from the burners. The proportion of these mixtures of hydrocarbons and inerts that can be added to normal gas is therefore limited, but blue water gas and Lurgi gas have relatively high flame speeds and low Wobbe numbers and so are very suitable for use with hydrocarbon gases. The neat hydrocarbons can also be added to the existing town gas in certain proportions, but their addition leads to an increase in calorific value and Wobbe number so that there is a limit to the proportion which may be added.

The whole range of hydrocarbons from methane to heavy fuel oil has been used to produce town gas. Methane obtained by mine drainage has been used at Point of Ayr[4] and at Whitehaven,[5] where it has been reformed to produce satisfactory town gas, and the recent importation of liquid methane may make it available in large quantities. Indigenous natural gas is being used at Cousland;[6] refinery tail gases are being reformed at Southampton,[7] Romford and the Isle of Grain, to provide a large scale base load source of town gas. Other hydrocarbons which have been used include light petroleum distillate butane[9, 10] and propane.[4]

Augmenting basic supply

Butane has been used by the Wales Gas Board at Abergavenny[11] where it has been mixed with producer gas to augment the basic supply of coal gas and at Aberavon[4, 12] in South Wales, where it has been mixed with producer gas and also added direct to coke oven gas. It has also been used at Spenborough[9, 10] by the North Eastern Gas Board to enrich blue water gas as well as producer gas to supplement the main supply.

Most of these applications have been for the continuous production of gas, either replacing or augmenting the existing supply. The hydrocarbons listed in Table 1 which are either volatile liquids or can be liquefied under pressure at atmospheric temperature, can be transported to gasworks some distance from the refineries at which they are produced; at the works they can be stored in the liquid state. Since these hydrocarbons are volatile, they can be converted directly into gas by means of a vapourising plant, and because they are of high calorific values, they provide a rich source of therms. They are, therefore, very suitable fuels for meeting peak load demands, and have also made possible the conversion of gas from carbonising plants in small, isolated, uneconomic gasworks to a supply of butane-air.

Low-boiling petroleum gases, particularly propane, diluted with air have been used for some time in the U.S.A. and on the Continent, as alternative supplies to conventional town gas. Such a supply was introduced at Whitland in South Wales in 1952[13, 14] to replace the existing town gas supply. Butane was used instead of propane because of its better availability. A mixture of butane and air containing 23% butane with a calorific value of 730 B.t.u. per cu.ft. and a Wobbe number of about 660 was supplied. The high calorific value chosen was equal to that being used on the Continent; it also had the advantage of increasing the thermal capacity of the mains and of producing a gas with a Wobbe number more in conformity with the rest of the country—in fact, a G5. gas. Owing to the lower flame speed of the

gas, however, it was not possible to use non-aerated burners, so it was necessary to enlarge the flame port areas of the aerated burners and to adjust their air-ports. Following the success of this venture, similar changes were made by the Eastern Gas Board in 1953 at Bungay in Suffolk and Framlingham in Norfolk.[16, 17] To be storing and distributing a mixture of an inflammable gas with air might at first seem to be rather alarming, but the concentration of butane used is well above the upper explosive limit of 8.5% butane in air.

Worsened combustion

Hydrocarbons have been considered for enrichment of town gas to meet the demand at times of peak load and laboratory tests were carried out on the use of benzole, naphtha, butane and propane respectively, observing the performance of appliances with these mixtures, and assessing the limiting proportions of each which would be acceptable. In a paper delivered to the Association in May, 1956. Grant[15] gave details of benzole enrichment at Fulham in February, 1956. Tests on appliances were carried out by Watson House with this gas.

As indicated by the prediction diagram, the addition of hydrocarbons resulted in worsened combustion, and also caused an increase in the sooting tendency of the gas. Sooting was most severe with benzole enrichment and least with propane enrichment. Where the addition of neat hydrocarbons is used to meet peak load demands, there is a disadvantage that only small additions can be made before unsatisfactory combustion or sooting occur, and it has been found that as little as only 1% or 2% can be added. Some reduction in demand can be achieved by increasing the Wobbe number of the gas, but this is only obtained by raising the calorific value of the gas above its declared calorific value and so supplying consumers with free therms.

Preliminary calculations

By using mixtures of hydrocarbons and air it is possible to augment output without altering the calorific value of the distributed gas. The amount of hydrocarbon-air which may, in fact, be added (and therefore the increase in volume output) is only limited by the resultant distributed gas giving a satisfactory performance. Preliminary calculations were carried out to assess the limiting proportions of air with benzole, naphtha, butane and propane respectively, which could be added to a mean G4. gas and still maintain a satisfactory performance. Tests showed that benzole—air and naphtha—air mixtures could each be added up to 17% for a final gas mixture with calorific value of 500 B.t.u. per cu.ft. Because of the greater availability of butane, however, the subsequent investigations were confined to the addition of butane-air mixtures.

A butane-air mixture with a calorific value of 500 B.t.u. per cu.ft. has a flame speed factor of 16 and a Wobbe number of 464; because of the excessive flame lift and the very low heat input, therefore, this gas cannot be used alone in G4, appliances, as indicated by its position on Fig. 1.

With the help of the prediction diagram, the effects of adding butane-air mixtures of a calorific value of 500 B.t.u. per cu.ft. to the gases produced by a number of stations of the North Thames Gas Board were examined and the theoretically maximum quantities which could be added were determined. The additions are for supplementing the gas supply at times of peak demand and an effect of butane-air additions is to lower the Wobbe number. The criterion adopted for the

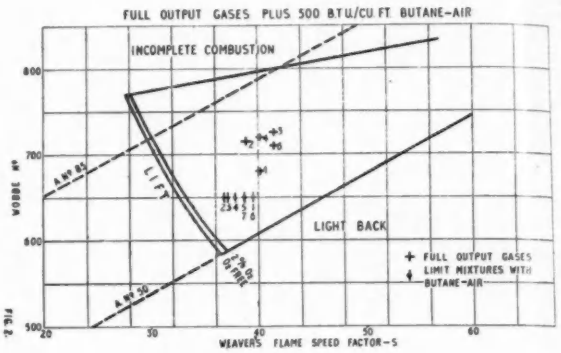


Fig. 2.

calculations has, therefore, been the lower emergency limit of heat input laid down, *viz.*, a Wobbe number of 650, and the base gases considered are those likely to be produced by the stations at times of maximum demand. Such gases are referred to in this paper as 'full-output gases.' The maximum amount of butane-air that can be added, and the expected properties of the gases are shown in Table 2, with the positions of the resultant gases on the prediction diagram shown in Fig. 2.

From 6-17% of butane-air with a calorific value 500 B.t.u. per cu.ft. can be added to the gases produced at these various stations, while the limiting factor in all these cases appears to be the Wobbe number since the estimated aeration numbers and reversion pressures are satisfactory.

If the calorific value of these gases is raised by adding more butane—*i.e.*, by using a mixture richer in butane—it will be seen from the diagram that the very high Wobbe number of the butane will raise the Wobbe number of the resultant mixed gas. This means that an increased volumetric addition of butane-air can now be made before the limiting Wobbe number of 650 is reached, so that the maximum output of the station can be increased still further. This, however, is achieved only at the expense of additional therms which it may or may not be possible to correct at some other time. The properties of the limiting gases of Wobbe number 650 of the stations when the calorific value is raised to

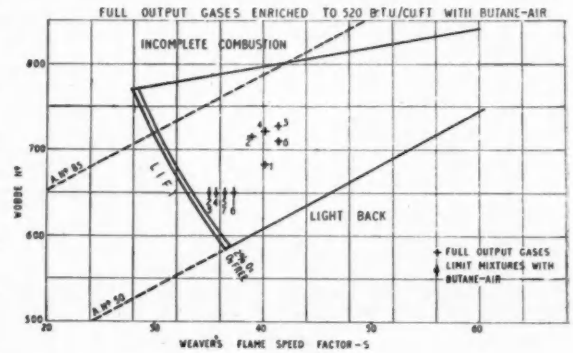


Fig. 3.

TABLE 2
Limiting mixtures of full output gases, 500 B.t.u. per cu. ft. with butane-air

Gas Works	% Butane–air	Specific gravity (air=1)	Wobbe number	Estimated aeration number	Estimated reversion pressure on jet size 3 (in. w.g.)	Increase in volume and thermal output (%)
No. 1	0	0·54	680	60	2·4	
	8·1	0·59	650	60	2·2	9
No. 2	0	0·49	715	70	2·4	
	14·9	0·59	650	60	1·9	17·5
No. 3	0	0·47	730	70	2·8	
	17·4	0·59	650	60	2·0	21
No. 4	0	0·48	720	70	2·7	
	16·2	0·59	650	60	2·0	19
No. 5	0	0·54	680	60	2·3	
	8·1	0·59	650	60	2·2	9
No. 6	0	0·50	709	65	2·7	
	13·6	0·59	650	60	2·2	16
No. 7	0	0·54	678	65	2·4	
	6·6	0·59	450	60	2·1	7

TABLE 3
Limiting mixtures of full output gases enriched to 520 B.t.u. per cu. ft. with butane-air

Gas Works	% Butane –air	Calorific value of butane–air mixture added (B.t.u. per cu. ft.)	Specific gravity (air=1)	Wobbe number	Estimated aeration number	Estimated reversion pressure on jet size 3 (in. w.g.)	Increase in volume output %	Increase in thermal output %
No. 1	15·1	632	0·64	650	60	2·0	18	23
No. 2	21·5	598	0·64	650	60	1·8	27	32
No. 3	23·2	579	0·64	650	60	1·8	30	35
No. 4	22·6	582	0·64	650	60	1·9	29	34
No. 5	15·1	632	0·64	650	60	1·9	18	23
No. 6	20·3	603	0·64	650	60	2·0	25	30
No. 7	13·7	648	0·64	650	60	2·0	16	21

520 B.t.u. per cu.ft. are given in Table 3 and the positions of these gases on the prediction diagram are shown in Fig. 3. With these gases the tendency to lift, as measured by the reversion pressure, is increased. Gases from stations 2 and 3, for example, are on the acceptable limit for lift.

The theoretical examination of the use of butane-air for peak loads shows that increases in output can be obtained without impairing appliance performance.

Laboratory tests on appliances were next made to test the validity of the predictions and since the first unit of butane-air for peak loads was planned for works No. 1, tests were made with synthetic gas mixtures based on the anticipated full-output gas of this works. The composition and properties of the gases used are given in Table 4 and they include gases with calorific values of both 500 and 520 B.t.u. per cu.ft.

Gas No. 1 represents the anticipated full-output of conventional gas from the works with a c.v. of 500 B.t.u. per cu.ft.

Gas No. 2 is a mixture of 90.3% gas No. 1 and 9.7% butane-air with a c.v. of 500 B.t.u. per cu.ft. which approximates to the calculated limiting mixture for a gas of a c.v. of 500 B.t.u. per cu.ft.

Gas No. 3 is a mixture of 89.7% gas No. 1 and 10.3% butane-air with a c.v. of 694 B.t.u. per cu.ft. and corresponds to gas No. 2 enriched with additional butane to give a c.v. of 250 B.t.u. per cu.ft. This has resulted in the Wobbe number being increased to 673.

Gas No. 4 is a mixture of 84.6% gas No. 1 and 15.4% butane-air with a c.v. of 630 B.t.u. per cu.ft. and approximates to the calculated limiting mixture for a gas of a c.v. of 520 B.t.u. per cu. ft.

The gases used for these tests were made up in wet holders from the distributed gas and adjusted with gases from cylinders to give the required compositions. The anticipated composition of the normal full-output gas was calculated from the probable maximum makes quoted by the works using typical analyses for the various types of gas.

Reversion pressure tests were carried out as described in GC35 with the gases containing butane on a range of Bray miniature and industrial jets and the observed prestures have been plotted against orifice area in Fig. 4.

Since experience shows that non-aerated burners are

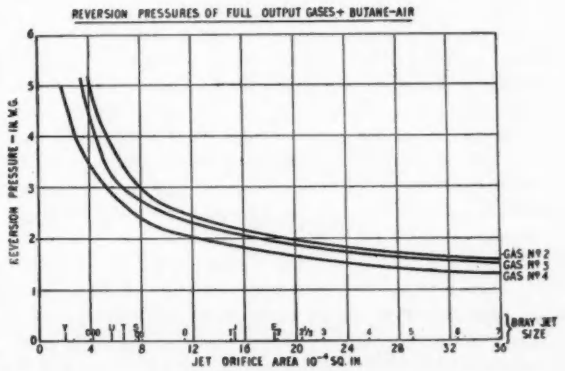

REVERSION PRESSURES OF FULL OUTPUT GASES+ BUTANE-AIR
REVERSION PRESSURE – IN. W.G.
JET ORIFICE AREA 10⁻⁴ SQ. IN.
GAS Nº 2
GAS Nº 3
GAS Nº 4
BRAY JET SIZE

Fig. 4.

TABLE 4
Gases examined in the laboratory

Analysis	Gas No.: 1	2	3	4
CO_2	3·9	3·5	3·5	3·3
O_2	0·8	2·4	2·4	3·3
CnHm	4·5	4·1	4·0	3·8
CO	18·7	16·9	16·8	15·8
H_2	46·7	42·2	41·9	39·5
CH_4	16·1	14·5	14·5	13·7
C_2H_6	1·4	1·2	1·2	1·1
C_4H_{10}	—	1·5	2·2	3·0
N_2	8·0	13·7	13·5	16·5
Specific gravity (air=1)	0·54	0·60	0·60	0·64
Wobbe number	680	646	673	650
Flame speed factor, S	40·1	37·9	36·4	36·0
Estimated aeration number	60	60	65	60+
Determined aeration number	66	63	65	65
Estimated reversion pressure (in. w.g.)	2·4	2·1	2·0	1·9
Determined reversion pressure (in. w.g.)	2·3	1·8	1·9	1·7

more prone to lift that aerated burners, a number of appliances with non-aerated jets were examined.

The gas used for these tests was No. 4 since it had the lowest reversion pressure—1.7 in. w.g. on jet size 3. The appliances were examined to discover whether there was any tendency for the flames to lift off the jets and whether lighting across was satisfactory, since cross-lighting becomes progressively more difficult as the reversion pressure is approached. The results of these tests are given in Table 5.

TABLE 5
Flame stability measurements on appliances on gas No. 4

	Jet Bray No.	Jet Size	Burner pressure in. w.g.	Performance
Space heating appliances				
No. 1	118	T	1·7 (ungoverned)	Satisfactory up to 3 in. w.g.
No. 2	,,	,,	1·7 ,,	Satisfactory up to 2·5 in. w.g.
No. 3	,,	U	1·6 (governed)	Satisfactory
No. 4	266	2	2·6 ,,	,,
No. 5	118	W	1·4 ,,	,,
No. 6	266	1½	2·2 ,,	,,
Water heating appliances				
Sink heater	266	2	2·0 ,,	,,
Open type sink heater	266	3	1·5 ,,	,,
Bath heater	266	3	2·0 ,,	,,
Wash boiler	118	S	2·2 ,,	,,

The results of the test showed that although the actual reversion pressures were slightly lower than predicted, flame stability was in every case satisfactory. No flame lifting occurred with the governed appliances and an appreciable excess pressure was needed with the ungoverned appliances before flame-lifting occurred. Since the aeration numbers of the gases were all above 60—as shown in Table 4—it was considered unnecessary to check aerated burners for lightback.

Gas fires are more prone to sooting than other appliances because they have very small combustion chambers and any increase in flame envelope can result in impingement of the flames on the cold radiants when the fire is first lit. For this reason tests were made with a number of gas fires and observations were made of the tendency for soot to form. Gas No. 4, which contained the maximum percentage of butane, was used for these tests and revealed no soot formation.

Since the Wobbe numbers of these gases are all lower than that of mean G 4. gas, the prediction diagram indicates that the combustion on these appliances should be correspondingly better. To confirm this, tests were carried out on an aerated cooker hotplate burner with mean G 4. gas and with gases Nos. 1 and 3. Gas No. 3 was chosen because it had the highest Wobbe number and would, therefore, be expected to give the poorest combustion performance. The results of these tests are given in Table 6, and show that in both cases the gases under consideration give better combustion than mean G 4. gas.

TABLE 6
Combustion tests on a cooker

Gas	CO/CO_2 at 2·5 in. w.g.
Mean G4. gas	·007
Gas No. 1	·004
Gas No. 3	·004

The results of these tests indicated that the proposed gases should be satisfactory, but it was considered desirable that tests on a larger range of appliances should be made when a trial of the plant at the works concerned was carried out.

The first trials of the butane-air plant at the works were unfortunately held in the summer when normal gas-making conditions and consequently the characteristics of the gas normally produced are somewhat different from those occurring during the winter when demand is at a maximum, the peak-load conditions under which it was intended that the butane-air additions would be made.

It was planned to make tests with the coal gas-carburetted water gas mixture as base gas with 10% butane-air added to give mixtures of calorific values of both 500 and 520 B.t.u. per cu.ft. Further tests were planned with similar gases but which contained 5% producer gas in addition, another constituent which reduces both Wobbe number and the flame speed of a gas. The actual composition of the gases tested are given in Table 7, and their positions on the prediction diagram shown in Fig. 5.

TABLE 7
Gas quality and compositions of gases examined

Composition Gas:	A	B	C	D
Coal Gas	67·5%	63·2%	58·1%	59·0%
C.w.g.	22·0%	27·2%	25·4%	26·5%
Producer gas	—	—	7·6%	5·0%
Butane (vapour)	1·6%	1·5%	1·4%	1·4%
Air	9·0%	8·1%	7·6%	7·9%
Properties				
C.v. B.t.u. per cu. ft.	500	521	497	507
S.Gr. (Air=1)	·51	·55	·58	·57
Wobbe number	701	701	651	674
Aeration number	62	64	59	61
Reversion pressure—in. w.g.	2·9	2·9	2·5	2·5

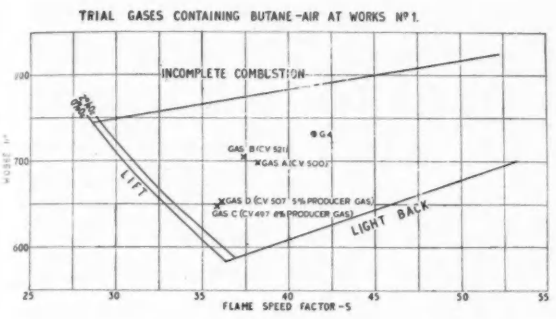


Fig. 5.

Three cookers were tested, two with aerated burners and one with non-aerated burners, for their combustion performance at 20% overload—to emphasise any differences—cross-lighting of the burners, stability of the oven burner when turned down, stability of the hot-plate burners at simmer setting and for the formation of soot on the underside of the vessel. All the combustion tests made were satisfactory; flame stability was good with all gases, the aerated burners showing no tendency to light-back and the non-aerated burners no tendency to lift, neither was there any tendency of soot formation with the non-aerated burners. The cross-lighting of the flames was slightly worse than normal because of the low Wobbe numbers of the gases; tests on flash tubes indicated that all the gases were satisfactory. Six different space heating appliances were examined for flame stability and cross-lighting, for completeness of combustion and for any tendency towards soot formation. Except for slight sooting on one gas fire the tests showed the gases to be satisfactory. Three types of water heating appliances were examined for combustion with satisfactory results.

Atmosphere examination

The method of examining glass-working burners was to adjust them on the normal distributed gas, to measure their cone heights and note the height variation with the various test gases supplied. The variations in aeration which did occur were in no case too great for the burners to be capable of re-adjustment to give the correct cone height.

A controlled atmosphere plant was examined by adjusting it to give a neutral atmosphere with the normal district gas and examining the atmosphere on subsequent test gases. These and other tests carried out in the laboratory indicate that the oxidising or reducing nature of the atmosphere is mainly a function of the Wobbe number of the gas, so that a 650 Wobbe number gas containing butane-air should give the same atmosphere as a 650 Wobbe number district gas without butane-air addition.

So far, consideration has been given to the use of butane-air as a supplementary gas for peak load demands. However, the favourable price of butane has lead to the consideration of its use as a base load constituent throughout the year. The limits imposed upon the use of butane for base loads are similar to those applying when it is used for peak loads, *i.e.*, that satisfactory appliance performance must be maintained.

Under normal conditions, it is advisable to maintain the heat input to appliances within ±5%, which means that the gas must be maintained within a narrower range of Wobbe numbers than is permitted at times of emergency, so the quantities of butane that can be added are more restricted. This is in contrast to the peak load conditions we have so far considered, when the Wobbe number tends to be low due to the high proportion of carburetted water gas and is permitted to fall to 650 during these periods.

Butane may be added for base loads in the following ways:

1. Addition of butane-air to supplement the normal makes of coal gas and carburetted water gas.
2. Enrichment by butane of gas of low calorific value caused by additional steaming during normal production.
3. Addition of butane to gas stripped of benzole to replace the therms so removed.

Each of these methods of use offers advantages.

1. The Wobbe number of the gas will be a maximum when coal gas without any added water gas is distributed, so that the maximum amount of butane-air which may be added will be to coal gas. Mixtures of vertical coal gas and debenzolised horizontal coal gas with butane-air added to give a calorific value of 500 B.t.u. per cu.ft. and a Wobbe number of 695 have been plotted in Fig. 6. Butane-air can of course be added to mixtures containing water gas. On Fig. 6 has been plotted a normal summer output gas plus butane-air to give a calorific value of 500 B.t.u. per cu.ft. and a Wobbe number of 695.
2. The effect of reducing the calorific value of vertical

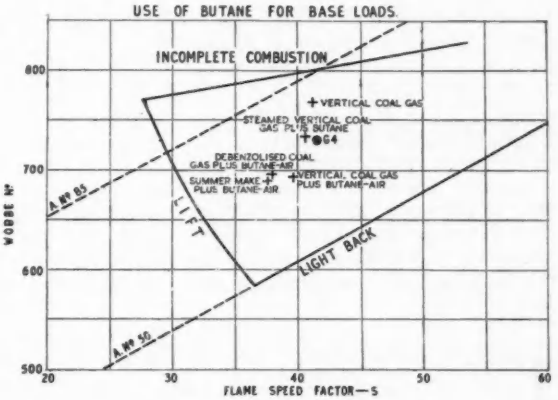


Fig. 6.

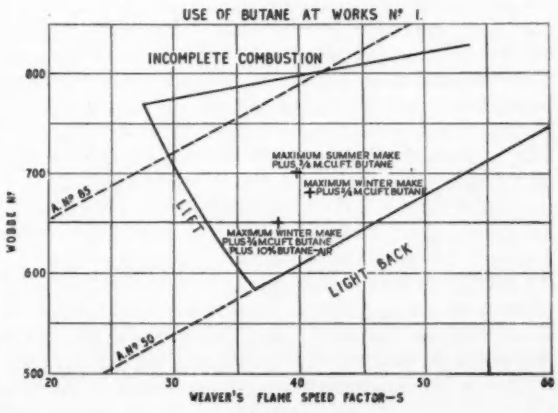

USE OF BUTANE AT WORKS Nº 1.
INCOMPLETE COMBUSTION
MAXIMUM SUMMER MAKE PLUS 3/4 M.CU.FT. BUTANE
MAXIMUM WINTER MAKE PLUS 3/4 M.CU.FT. BUTANE
MAXIMUM WINTER MAKE PLUS 3/4 M.CU.FT. BUTANE PLUS 10% BUTANE-AIR
A Nº 85
A Nº 50
LIFT
LIGHT BACK
WOBBE Nº
WEAVER'S FLAME SPEED FACTOR—S

Fig. 7.

coal gas by steaming is to increase the volume output. If the calorific value is restored by butane addition, both thermal and volume output are increased. The effect of steaming vertical coal gas to a calorific value of 475 B.t.u. per cu.ft. and then enriching to the original calorific value of the coal gas has been calculated. The positions of the coal gas and the gas after steaming and enrichment have been plotted in Fig. 6. From Fig. 6 it is clear that the butane mixture is a satisfactory town gas although of a slightly high calorific value. It can be reduced to 500 B.t.u. per cu.ft. by mixing it with 7% blue water gas, giving a resultant Wobbe number of 714.

Substantial additions of butane can, therefore, be made without the resultant gas giving unsatisfactory appliance performance. Because of its low plant and labour requirements, the cold enrichment of gas with butane or with butane-air is an attractive method of augmenting output. The limit to the proportion of butane-air which can be added is normally set by Wobbe number considerations, but at times of peak demand, lower Wobbe numbers than normal can be tolerated for short periods. For appliances adjusted for G 4. gas, the tests have shown that approximately 10% butane-air mixture can generally be added, but this proportion may be increased if the output calorific value is raised; this has the effect, however, of increasing the tendency of the gas to lift.

When butane or butane-air is used as a base load constituent the proportions which may be used are smaller because it is necessary to maintain the Wobbe number of the gas between closer limits. However, because of the high calorific value of butane, the thermal contribution to the district supply is considerable.

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NEW BOOKS

Advances in Petroleum Chemistry and Refining. Volume 2. Edited by Kenneth A. Kobe and John J. McKetta, Jnr. Interscience Publishers Inc., New York and London. Price £5 4s. 0d.

IN the introduction to the first volume, published last year, we were led to expect further volumes each succeeding year. This promise is being fulfilled by the publication of this second volume and it says a great deal for the energy and breadth of knowledge of the editors that the subjects dealt with are so diverse, so clearly topical to the petroleum industry and so different from those appearing under the same general headings, under which the book is planned, in the first volume.

It is written and edited by American scientists and technologists, specialists in their particular branches of petroleum technology, so that their views may be taken as authoritative. The non-expert reader, however, is once again impressed by the enormous field covered by the petroleum industry, economic trends, chemical engineering, chemical synthesis, radiation techniques as well as mechanical equipment; a perusal of the contents not only confirms this, but shows that each subject has been treated in the greatest detail. As a means of keeping petroleum technologists up to date in their knowledge of recent advances in their particular fields, this annual series of publications should be of the greatest value.

We noted an allusion in the early part of this volume to the death of one of the editors, Dr. Kenneth A. Kobe, and trust that this will in no way affect the publication of future volumes.

The Engineer, Buyers' Guide, 1959. The Engineer, 28, Essex Street, Strand, London, W.C.2. Price 7s. 6d. (9s. 3d. including postage).

THE 1959 Edition of the *Buyers' Guide* upholds the traditions of previous years and is a most useful reference book to engineers and others who need to know the particulars of those firms with which they are accustomed to deal or may be on the lookout for suppliers of hitherto unfamiliar plant, engineers' tools or raw materials.

In this edition, which contains 744 pages, are listed over 33,500 entries arranged under some 2,500 classified headings with 1,500 cross references to assist users in finding what they are looking for.

This year, for the first time, are included details of the nationalised industries under the heading 'national undertakings.' Here can be found the addresses and telephone numbers of the different divisions of the nationalised boards; those for the area gas boards' headquarters as well as their subdivisions.

*Discussion of Communication No. 551**

OPERATION OF LIQUID AND GASTECHNIK PURIFICATION PLANTS AT CARDIFF

By J. Powdrill

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GENERAL MANAGER AND ENGINEER,
CARDIFF UNDERTAKING, WALES GAS BOARD.

Mr. C. T. Hawkes, Humphreys and Glasgow Ltd.: 'Besides the conventional oxide box there are very few processes which will remove hydrogen sulphide to the limits required by statute in this country. Here in one paper you have a wealth of useful information on two entirely different processes, both of which are capable of satisfying the requirements of the Gas Referee and from which you can make your own comparisons. I propose to confine my remarks to the Manchester process, with which I am more familiar, and hope that others coming after will do the same for the Gastechnik process.

'The design of the Manchester plant at Cardiff was governed, as Mr. Powdrill says in his paper, by the fact that it was to handle only carburetted water gas and producer gas intermittently and according to the demands of the gas grid. It had, therefore, to be capable of being started up on full load in the time required to raise heats in carburetted water gas plant and also to shut down at a moment's notice.

Simplified

'Such conditions meant that with planned maintenance, standby equipment could be dispensed with and the plant greatly simplified. With the exception of the reagent preparation and sulphur recovery sections, the whole of the plant stands in the open, and the pumps are placed at the point they are wanted, thereby cutting pipe runs to a minimum.

'The only standby prime mover provided is the reagent pump as a failure in reagent supply is rapidly reflected in the performance of the plant. All Cardiff's prime movers are designed to work for long periods without attention and in fact they have run for 12 months between overhauls.

'Each pump is provided with a spare rotating unit, comprising impeller, shaft, bearings and mechanical seals. With a split casing type of pump a complete rebuild can, therefore, be carried out in a comparatively short space of time.

'The fact that no standby pumps are provided greatly simplifies the valve arrangements. The control of the discharge of each pump is pre-set by a butterfly and no isolating valves are provided, the pipe work being so arranged that only a very small amount of liquor has to be drained out locally when a pump is opened up for overhaul or inspection.

'The weakest link in the Manchester process, as with nearly all similar processes, is the oxidation or regeneration stage and considerable effort has been expended to ensure that this part of the process is both simple and reliable. As Mr. Powdrill says, the use of injectors does not materially reduce the power consumption over more conventional methods but it does do away with the necessity for an air compressor and for cleaning ceramic or canvas diffusers, while at the same time providing an intimate mixing of air and foul liquor. There are also indications that this method of oxidation reduces the formation of stable froth in the oxidisers and enables it to be broken down quite easily by simple means into separated air and liquor.

'Another most important part of the process is the preparation of the fresh reagent. Originally at Cardiff, because the plant was only to be operated intermittently, the reagent mixing and dosing was made very simple and depended on supervision by an operator. However, it was found that occasionally the freshly prepared iron suspension was comparatively unreactive and if not corrected, a falling off in purification efficiency resulted. This would not matter very much providing early warning of such falling off could be obtained, but as there is no quick and easy method of continuously recording very small amounts of hydrogen sulphide, there was always the danger that changes might go unnoticed.

'The very simple dosing gear fitted to the plant was an attempt to reduce the risks of an undetected rise in outlet H_2S and at the same time to do away with the necessity for continual supervision. This is a step in the right direction, but I do feel that there is still a lot of work to be done on reagent mixing and control, especially as the cost of reagents now appears to represent over 30% of the gross running costs of the plant.

'On the Cardiff plant there are practically no instruments—each of the pumps has a pressure gauge on the discharge side and each starter has an ammeter. There is also a simple differential pressure gauge recording the pressure drop across the plant. No other instruments are provided apart from float operated and pressure switches which give audible warning if, for any reason, a circulating pump should shut down.

No corrosion

'Owing to the almost complete absence of hydrogen cyanide and ammonia in the gas there has been no sign of corrosion in the plant. It has been demonstrated elsewhere that the presence of suspended iron in the circulating liquor is not only essential for purification but also as a corrosion inhibitor, and a lack of iron suspension results in attack of the steelwork, especially in the oxidisers.

'In the early days of the process some difficulty was experienced in the blockage of the wood grid packing of

**An abstract of the paper, delivered to the 96th A.G.M. of the Institution of Gas Engineers, was published in our June 10 issue.*

the purifier towers. Experience showed that irrigation rates far greater than theoretical were necessary to prevent the gradual build-up of solids and blockage of the packing. This tendency to block, moreover, was more pronounced in towers dealing with increased concentrations of hydrogen sulphide, and we believe that this may, in some measure, be due to the fact that with H_2S concentrations of about 120 grains per 100 cu.ft. or more iron sulphide is formed in the gas washing tower. This was the reason for providing the first tower without any packing and for removing part of the packing in the second tower.

Distribution grid

'In order to improve the efficiency of the empty tower and to produce a high drop density a special metal distributor grid with serrated lower edges was developed and by this means it was possible to obtain irrigation rates of about 1,100 gal. per sq. ft. per hour while still preserving individual droplets in the free space below the grid.'

Mr. H. Johnston, Member and Chief Engineer, North Eastern Gas Board: 'Following promising experience with a small experimental three-tower .5 mill. cu.ft. per day plant at Royston, installed to augment purification of purchased coke oven gas with an H_2S content of 700-750 grains per 100 cu.ft., a decision was taken to install larger plants at Hull and Scarborough.

'It was known that overall costs of purification by pelleted oxide would be higher than would have obtained with static purifiers, but in compensation the Gastechnik process offers advantages of compactness, saleable sulphur and cleanliness.

'The Hull plant has two parallel streams each of three towers to purify 4 mill. cu.ft. per day. So far only one stream has been operated. At Scarborough there is one stream of three towers to purify 3 mill. cu.ft. per day which has not yet been put to work. An extraction plant is installed at Hull to deal with spent pellets from both Hull and Scarborough towers.

'The installations are similar in design to that at Cardiff, the main exceptions being that the top lock arrangement is external to the tower with pellet admission through an 8-in. Audco cock. It was thought that the cone valve arrangement internal to the tower as at Cardiff, being more inaccessible, could be troublesome in maintenance.

'Mr. Powdrill stresses the need for good ventilation in the building housing the extraction plant. The vapours of all chlorinated hydrocarbons have anæsthetic properties and will give rise to toxic effects in persons exposed to them. Their use is covered by the provisions of the Factories Act 1937, Sections 27 and 47(1). For those reasons the extraction plant at Hull is in the open—incidentally there is a saving in cost.

'Experience in Germany with Gastechnik towers is limited to the removal of about 300 grains per 100 cu.ft. Cardiff removes 350 grains. At Hull the plant is required to purify to statutory standards vertical retort coal gas with an inlet H_2S concentration of 650 grains per 100 cu.ft. In actual fact over 12 months the inlet H_2S has ranged from 410 to 680 grains with an average of 540 grains per 100 cu.ft.

'There is no question that pelleted oxide will remove H_2S to statutory standards, but the economics of the system hinges on the ability of the plant to produce spent pellets of the maximum sulphur loading, especially when an extraction plant is to be used. By maintaining the sulphur loading at a maximum the minimum amount of pellets is circulated, and this in turn means the minimum of handling, of extraction treatment and of pellet loss by abrasion. Experiments on the small plant at Royston showed that new pellet requirements were 17% greater when the sulphur loading was 20% than were required when a sulphur loading of 30% was achieved.

'Mr. Powdrill states that loading of pellets to 30% by weight is about the maximum obtainable, and I believe this is true. Is an average of 30% regularly obtained at Cardiff? The average at Hull is now about 28%. We hope to improve on this. Much depends on the critical factors of control, *i.e.*, moisture content, temperatures, air admission and the cycling of pellets. Original estimates of operational costs were based on a pellet loading of 30% sulphur, subsequently extracted to 6% sulphur, *i.e.*, a net extraction of 24%. Present working averages 28% loading with subsequent extraction to 8%, *i.e.*, a net extraction of 20%. We have no doubt that this can be improved.

Crust formation

'Mr. Powdrill refers to tower blockages. If this is meant to be complete cessation of pellet flow, then it has not been experienced at Hull, although on one occasion it occurred at Royston. There has, however, been a hard crust formation of cemented pellets on the inside periphery of the first tower to a thickness of 9 in. and practically the full depth of the tower. This is attributed chiefly to high temperatures and is not likely to occur again.

'I agree with Mr. Powdrill that moisture can have serious effects if allowed to persist. Tar and moisture particles tend to choke the oxide pores to the detriment of the oxide surface. I also agree that regular pellet movement must be maintained. When putting the Hull towers to work gas was passed for a time without pellet movement, producing conditions difficult to rectify. Towers may be stood without pellet movement so long as there is no gas flow but not otherwise. At Hull regular pellet movement is now operated every day.

Reactivity

'Slight difficulties have been experienced at Hull in maintaining reactivtiy in the third and final tower. This tower is normally charged with new or extracted pellets. Extracted pellets usually have a low moisture content around 3%, whereas requirements demand an average of about 10%. Extracted pellets also have a sulphur residue of 6% to 8% which undoubtedly reduces activity. It appears necessary to charge the third tower with new pellets and not extracted pellets.

'While temperature rises uniformly in the sulphiding and revivification zones in Nos. 1 and 2 towers, it falls off again in No. 3 tower. We are attempting to maintain the necessary temperature for reactivity at Scarborough by lagging the third tower. I would appreciate Mr. Powdrill's views on maintaining reactivity of pellets in the final tower.

'Mr. Powdrill remarks on the blue compounds forming on the outer crust of the pellets and due to cyanogen compounds in the foul gas. This same formation has been evident at Hull and Royston. These compounds accumulate at a slow rate since a proportion is lost from the surface by abrasion. At Royston the effect became most evident as the overall age of the pellets in use increased. It was estimated that over 12 months working the blue compounds cause a 5% reduction in the sulphur compounds of spent pellets.

'The sulphur extraction plant has worked with much less trouble than was anticipated, though we are not recovering sulphur with the same degree of purity as at Cardiff, the figure being round about 96% purity. Although there is an efficient electrodetarrer in the line it may be necessary to line up an oil washer for extraction of condensable hydrocarbons.

'We have not yet been able to obtain sufficient washes in the eight-hour cycle to reduce the sulphur content of the pellets to below 6 or 8%. Time for de-watering is nearly twice that mentioned for Cardiff.

'There were some fears of corrosion

in the extraction plant. Corrosion is most likely to occur in locations where vapours are condensing. Temperatures above 300°F. are liable to cause breakdown of solvent with the formation of hydrochloric acid. Recently at Hull there has been experienced a major leakage on the still condenser the tubes of which were of titanium alloy stainless steel. New tubes of molybdenum alloy stainless steel are now being fitted. I would appreciate information on any corrosion troubles at Cardiff. Are any particular safeguards taken to prevent hydrochloric acid formation? Costs quoted in the paper exclude repairs and maintenance which, of course, must eventually be included.

'Generally the Hull towers and extraction plant are performing their intended purpose. It is a new process with promising rewards. Difficulties met do not so far reflect on reliability but rather on operating costs and are regarded as not unexpected teething troubles. With the contractors, Robert Dempster & Son, Ltd., we are hopeful that reasonably low-cost working will be achieved. It is not yet possible to quote full working costs for comparison with Cardiff, but at best I believe they will be somewhat higher, possibly because of the larger capacity of the Cardiff plant.'

Mr. L. G. Townsend, Chief Chemist, Liverpool Group: 'I am particularly interested in the Manchester liquid purification plant described in the paper, since it presents certain improvements not available for the installation at Liverpool described in I.G.E. Comm. 429. The Cardiff plant went to work some six years after the Liverpool plant, and more than ten years after the original plant at Droylesden, Manchester. Some of the design data for the Cardiff plant were obtained from small-scale experiments carried out on the Liverpool plant, and the more recent plant had, therefore, the benefit of our experience at Liverpool.

New ground

'It might be thought, therefore, that the plant was not breaking new ground. It must be remembered, however, that the Cardiff plant was the first one to be designed to work expressly on gas free from cyanide, and experience at Liverpool of purifying various gas streams showed that purification would be more difficult for that reason, particularly from the aspect of removing the final traces.

'The main difference at Cardiff lay in the use of liquid operated air ejectors for oxidation for the first time. It has always been evident at Liverpool that the plant capacity and, therefore, the running costs were dependent largely on the oxidation side of the process. The efficiency of air usage at Liverpool was low—in the region of 7%. It is not possible from this paper to deduce the corresponding figure at Cardiff, and I should like to have this figure, since it is a direct assessment of the improvements effected.

'When we come to power consumption, we find that the Liverpool plant drive takes 110 h.p. as against 245 h.p. at Cardiff or 3.1 h.p. per mill. cu. ft. at Liverpool as against 4.1 h.p. per mill. cu. ft. at Cardiff. Since the Liverpool plant purified gas containing 700 grains H_2S as against 350 grains at Cardiff, the later plant demands considerably more power, particularly on the basis of tons of sulphur removed from the gas.

Eliminating soda ash

'The copperas usage is practically the same on both plants and Liverpool has operated for an extended period with ammonia, eliminating the use of soda ash entirely. Nevertheless, the costs, even in the most favourable circumstances, are not less than .3d. per therm, which is appreciably more than for oxide boxes.

'The sulphur recovered with such a low concentration of hydrogen sulphide and in the absence of cyanide presents quite a difficult problem which has not been completely solved. The use of cyclone pattern defrothing units is novel and successful and although there was no difficulty in this respect at Liverpool, it may well be that the injectors produce a more finely divided and aerated sulphur, thus making their use desirable, if not essential. I am very interested to know whether any success was achieved in attempting to coagulate the sulphur by boiling, since this was a feature of the Liverpool method of recovery.

'It is very interesting to read that the system had to be split into two circuits, whereas at Liverpool the reverse operation was carried out. This, again, is almost entirely due to the absence of cyanide giving a lower equilibrium hydrogen sulphide concentration in the outgoing gas at Liverpool. The inference here is that a much larger effort is being put into removing the last traces at Cardiff than would be necessary if cyanide were present. In spite of this, there is an indication in the table on [p. 15] that .5 ppm. is about as low a concentration of hydrogen sulphide as can be achieved, although there may be some improvements in winter. The higher sulphur loading at Liverpool did not permit the luxury of a final circuit with very little work to do. It is evident that there are still possibilities for this type of plant in special circumstances, in spite of the rather high cost.

Detailed costs

'Turning now to the Gastechnik process, this is probably the first time that detailed costs have been given for the process, and I should like to ask if the figures given are based on actual data at Cardiff or whether they are at this stage theoretical. So much depends on pellet wastage which accounts for nearly half the process costs that confirmation of a wastage figure of 10% would be very valuable. It seems to me that the process economics are very much dependent on the size of the unit, and the author's pelleting plant is apparently of adequate size for future requirements. The capacity of the recovery plant is, however, not quite clear, and it would seem that centralised sulphur recovery within a reasonable area would be logical. Is this what the author has in mind?

'The question of the low sulphur and moisture contents of the spent pellets prompts me to question the extent to which migration occurs in this process. How is the moisture content of the new pellets controlled and is this related in any way to the hydrogen sulphide content of the gas? The high operating temperatures would seem also to conflict with good migration, and it would be most interesting to know if any signs of migration can be observed in semi-spent pellets.'

Mr. B. C. Morton, Robert Dempster & Co. Ltd., 'Mr. Powdrill has ably described the manner in which pellets are almost completely regenerated *in situ,* and therefore there is no danger of firing when they are discharged from the towers. Nevertheless, abnormally high temperatures are not encountered at the critical zone within the towers. Oxygen recorders can be employed at the outlet of each gas stream controlling the additional quantity of O_2 injected at the inlet, and be fitted with a temperature override at the regeneration zone of the first tower as a safety check.

Detrimental

'We would have expected that with 300 grains/100 cu.ft. the heat of regeneration in the first two working towers might be incapable of maintaining the gas temperature above dew point in the third tower, and deposition of water to excess might result, with detrimental effect on the activity of the pellets to remove final traces. The author's views would be ap-

preciated. In any case the trouble could readily be overcome by the installation of heaters at the Nos. 2-3 tower cross-over, or the lagging of the third tower.

'Referring to the diagram [Fig. 13 in the paper], it is customary for my company to recommend that make-up pellets be fed only to the final towers, so that new oxide meets out-flowing gas in the true counterflow, and effectively removes final traces of H_2S. Similarly, all extracted pellets would be charged into No. 2 tower and both new and extracted moved forward up the stream, finally to be taken from No. 1 tower fully charged with sulphur. By contrast with this system, Mr. Powdrill has apparently devised a method of mixing new and extracted pellets and feeding them in the proportion of roughly 3 : 2 : 1 into Nos. 1, 2 and 3 towers respectively, contrary to known practice both in this country and on the Continent. No doubt he has good reasons for this departure, but I would appreciate an explanation and some indication as to how he has apportioned the mixed quantities of pellets to the respective towers without sustaining fall in plant performance.

Sulphur residue

'It would be interesting to have information as to the manner in which the H_2S is absorbed and the regeneration reaction functions within the body of each single pellet. One might have expected sulphur formed on the outer surfaces would prevent reduction to the sulphide within the core. Clearly, if unregenerated sulphides remain sealed within the pellet core, they could not be recovered as sulphur in the perchlorethylene washes. In such case what proportion of the sulphur residue in the pellets is due to washing inefficiency or insufficient regeneration in the towers? Has the author any information on this aspect?

'The concentration of the entire plant, including pelleting and recovery of sulphur in saleable form, at Cardiff should make the process outstandingly attractive, especially as it would be geographically well based there. It is logical for the Gas Board to consider making their own pellets, except presumably for first filling, so as to reduce cost and avoid the need for bagging and distant transport, and obviate the need for large stocks. The production of a standard pellet is a less simple problem than might be expected, as the process is bound by narrow limits and requires a fair degree of skill or "feel" by the operators. Slight variations in the conditions and constitution of the raw materials can have immediate effect on the extrusion rate and overall efficiency of production. Such difficulties are, however, not insuperable, and will no doubt be overcome by the Gas Board as experience is gradually acquired. In any case, my company's experience is available to help.

Rational integration

'At present, the plant is essentially installed in three separate units, namely, the H_2S removal towers, pellet screening and sulphur recovery plants. It would seem rational to attempt to integrate these three sections to reduce still further pellet handling, ground space and capital costs, and no doubt improvements will follow this direction. The sulphur recovery section could be simplified in design and the quality of sulphur improved by more effective filtration. All this makes clear that while the process presents a plant challenging in design and economics, it lends itself to further evolution with simplifications to reduce operating costs and thereby counteract the anticipated fall in the price of sulphur.

'The plant can be adapted for high pressure duty where the H_2S burden is sufficiently low so that the content in the compressed gas does not exceed the practical limits of the process. Such an installation would be identical in design, and there is one working at 450 p.s.i.g. at the Billingham works of Imperial Chemical Industries Ltd.

'From the paper the reader might get the impression that considerable supervision is essential to take temperature readings and tests for H_2S at numerous points in the plant; actually the plant is instrumented beyond the practical needs of day to day working, and no doubt the Gas Board will be able to reduce technical work considerably as confidence increases in the ability of the plant to perform the required duty.'

Mr. L. A. Ross, Works Manager, Stapleton Road, Bristol: 'Turning to specific points, one finds on [p. 6] reference to one of the bugbears which has affected most of the plants in the country, whatever their personal idiosyncrasies in other directions, *viz.*, the proneness to blockage of the washer grid filling. It would be interesting to know what design of filling was ultimately adopted at Cardiff and whether it is now anticipated that blockage is a thing of the past. At Bristol very considerable difficulty indeed existed in the early days of the plant's life and "blowing" of the washers with compressed air was necessary to keep back pressure within reasonable bounds. The adoption of a splash plate type light angle filling has vastly improved conditions, but it is still expected that cleaning will be necessary every two or three years; construction is now such, however, that very rapid cleaning should be possible. It is noted on [p. 6] also that, owing to unsatisfactory performance initially with a single liquor circuit, a two circuit system was finally adopted. In spite of what Mr. Townsend has said, I noticed that he thought there was a lot to be said for the two circuit system in his paper in 1952. At Bristol a single liquor circuit is in operation, freshly prepared ferric hydroxide being fed to the first washer and sodium carbonate to the fifth (*i.e.*, last) washer. Could the author tell us whether satisfactory performance could have been achieved at Cardiff with the single circuit system had sufficient reagents been used. This point is interesting to us in that reagent consumption at Bristol is very high compared with the Cardiff figure, even allowing for the H_2S content of the gas at Bristol being at times almost twice as great; it is noteworthy that as with the Cardiff plant "blues" play no perceptible part in the performance of the Bristol installation.

'It is assumed that the decision not to provide standby equipment on the Cardiff plant [p. 3] indicates that an alternative means of meeting the gas load existed in the event of breakdown, having regard to the almost instantaneous breakthrough (20 seconds) of H_2S in the event of circulating liquor pump failure. Would the author not consider standby plant essential in the case of a baseload station? At Bristol diesel-driven pumps and compressors are provided which come into action automatically on main electric supply failure. Not only has this arrangement justified itself on one such occasion of supply failure, but also its use on numerous other occasions has avoided the incurring of high electrical maximum demand charges.

Disappointing

'The whole aspect of ultimate sulphur recovery is one of the most disappointing features of the whole process, the expectation of seven years ago of a high price for refined sulphur having given place to the realities of a falling price consequent upon a growing surplus of world production and a realisation of the intractable nature of the problem of recovery of sulphur from the complex slurry which the plant produces. Is it considered from experience at Cardiff that the product referred to on [p. 17] is the best that can be economically achieved? At Bristol, where various factors have precluded earlier an intensive attack on the problem, consider-

able investigation has recently been undertaken on the recovery of a more refined product, so far with little result other than the accumulation of a considerable amount of knowledge which does not give grounds for wild optimism.

'One notes in the paper that what small revenue is credited to the sulphur is on the basis of spent oxide price, which for plants remote from the buyer is likely in any event to result in a debit transaction.

'Apart from the fact that acid manufacturers are now refusing to accept L.P.P. sulphur admixed with spent oxide owing to the deleterious effects of the alkaline salt content in their sulphur burners, is it not considered humiliating to have to rely on the process which the liquid purification plant was to replace to dispose of its product?

'On the bright side, we at Bristol can confirm the reliability of the plant to meet statutory requirements as regards gas purity, even at overloads of up to 10% for an appreciable period (and with a reasonable factor of safety).

Credit due

On a final point, we respectfully suggest that the author has not done full justice to the plant on the score of net cost by omitting the credit due to reduced oil consumption at the water gas plant resulting from the absence of need for air admission with this plant as would have been necessary with orthodox oxide purification; to the reduced oil consumption due to the absorption of CO_2 by the circulating liquor and to the reduced steam consumption at the exhausters by reason of the lower plant back pressure. At Bristol where continuous vertical gas only is purified at the L.P.P. the first two items result in a coal saving and a reduction in coke made. With the present state of the coke market, this results in considerable saving in handling and degradation of coke and, with the third item referred to, can be shown to result in an overall credit to the plant of something in excess of .10d. per therm.

'Turning now to part 2 of the paper, one must congratulate the author on the excellent results and net costs of the Gastechnik plant.

'Apart from the refined sulphur produced with relative ease, the attractive feature of the plant from the works engineer's standpoint is the high overload capacity which permits the isolation of any one stream should abnormal circumstances so dictate and the elimination of the need periodically to recruit a relatively large gang of men for box changing.

'At Bristol, the Gastechnik plant was ordered at a time when the liquid purification plant was still behaving erratically and likely to pass small amounts of H_2S without warning, and the need for an insurance against enforced interruption in gas production was paramount.

'It was naturally anticipated that with towers acting as catch boxes condensation might be a problem, and this has in fact proved to be the case, the building up of a wet conglomerate of dust and pellets at the base of the towers resulting in severe back pressure and channelling problems.

'The results following experimental lagging of a pair of towers recently, however, has so far given every cause for optimism and it is expected that when all towers are lagged the installation will prove to be a completely reliable catch series. Even before the effects of condensation became pronounced the plant proved itself capable of satisfactory trace removal and of removing appreciable amounts of H_2S for prolonged periods. The decision to use fouled pellets at Cardiff for tower filling should eliminate the very serious breakdown which occurs when new pellets are used, serious both as regards financial loss and effect on plant performance.'

Mr. K. W. Francombe, Whessoe Ltd., in a written contribution, 'At Cardiff they start off on an easy wicket with only 350 grains H_2S per 100 cu.ft. The initial development and continued operation of both systems must have produced a number of headaches. Perhaps the absence of gas manufacturing problems has allowed the staff more time to handle such awkward unit operations as sludge filtration, boiling perchlorethylene sulphur extraction, pelletising, etc.

World surplus

'The end result seems that the Manchester process costs about .5d. per therm (when including all capital charges), and the Gastechnik system perhaps .3d. per therm (including interest and maintenance), although unfortunately the capital cost is not given. The latter system is of course dependent upon obtaining £9 per ton for sulphur of, say, 98% purity, and I wonder if this will obtain when the French plant at Lacq is in full swing and there is the world surplus to which Mr. Powdrill refers. I am tempted to ask Mr. Powdrill whether he would repeat both experiments if starting anew, and if so why he installed the Gastechnik system rather than extending the Manchester system.

'I believe the cost of orthodox oxide box purification seldom exceeds, say, .2d. per therm and I remember reading a paper from the N.W.G.B. showing that in certain favourable circumstances box purifiers could be operated at a profit.

'In recent years there have been at least three costly attempts to perfect "dynamic" systems of purification using granular oxide—or what I prefer to call "the moving-burden" technique. Periodic references have appeared in the technical press and I therefore make no apologies in referring publicly to their demise. I can now reveal that the Whessoe moving burden system (B.P.'s 695, 355 and 707,178) has been abandoned after a prolonged commercial-scale test by the Northern Gas Board, and I gather the other two somewhat analogous experiments have likewise been terminated.

'May I conclude by briefly touching on the reasons for the Whessoe decision. They were:

1. The additional trouble and cost of drying imported bog-ore from over 40% to about 15% moisture content, the maximum for easy gravity flow through tall vertical towers.

2. The size degradation resulting from recirculating the oxide, resulting in excessive back pressures despite a fairly short horizontal cross-flow path of gas through a tall vertical bed.

3. The static condition of the oxide in the louvres through which the crude gas was admitted into the bed, resulting in severe caking at these points with further excessive pressure losses.

'Although we found means for overcoming these and several other minor troubles, the cost of the finally modified system, basically only suitable for fairly large gas volumes, would have risen beyond that of modern mechanised tower purifiers and we assessed that gas engineers would not pay more for the moving-burden system despite certain inherent advantages of the technique. The experiment was therefore finally abandoned on economic rather than on technical grounds.'

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